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The School Mathematics Study Group of Stanford University is conducting a 4-year longitudinal study of mathematical learning in the primary grades. The purpose of this paper is to present the results of this study for the kindergarten year. Approximately 2,000 kindergarten children from two large cities were divided into lower and middle income groups. One group from each income level used the School Mathematics Study Group curriculum, and one group from each used the Science Research Associates Program. A battery of tests (K01) was administered to the children in September to evaluate their ability upon entering kindergarten, and a second battery (K02) was administered in May to measure gain. The tests measured cognitive processes and mathematical achievement. The lower socioeconomic group performed consistently less well than the middle income group on all K01 tests except the test of visual memory. This same pattern persisted in K02 tests, even though the entire sample showed significant mean score increases from K01 to K02. Differential gains were found, however, between the two income groups, the lower group showing a greater gain on five tests, the middle group showing a greater gain on three tests, and no difference existing on five tests. (WD)

THE ELEMENTARY MATHEMATICS STUDY:

AN INTERIM REPORT ON KINDERGARTEN YEAR RESULTS

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Particular appreciation is expressed by the authors, as well as by the other research staff, for the fine cooperation of principals, teachers, and administrative personnel of the two school systems involved in our study. They have given generously of two highly valued commodities, namely, time and space, along with many constructive suggestions for facilitating this long-term study.

Although this particular report is authored by two individuals, it contains the endeavors of many people, but most importantly Dr. E. G. Begle, Mrs. Terry Chay, and Mr. Edward Cruz.

Above all, our thanks are indirectly extended to the wonderful children who have willingly, and usually eagerly, entered into the testing.

I. Purpose of the Elementary Mathematics Study

In the fall of 1966, the School Mathematics Study Group embarked upon a four-year longitudinal study of mathematical learning in the primary grades. The primary purpose of this study is to assess children's progress in learning particular mathematical ideas during the beginning school years. With these findings, the possibility exists of developing, in the future, more effective materials for teaching children coming to school with differential pre-school experiences.

II. Description of the Sample and Research Design

The study population includes approximately 2000 children entering kindergarten in selected schools of two large cities. The schools selected met two criteria: they drew on residential areas which could be readily defined as either lower or middle income groups, and each particular group of elementary schools fed into a common junior high school. Within one city, four cells were formed, two each from lower income areas and two from middle to higher income areas. One lower and one middle income cell are using the School Mathematics Study Group curriculum, and the other, comparable cells are using the Science Research Associates Program which is the state adopted mathematics text in California for the primary grades. In the second city, three cells were formed, the omitted cell being the middle income SMSG curriculum group.

Inservice training was provided to all of the teachers. A team of two instructors, a mathematician and an elementary teacher with considerable experience both in the classroom and with mathematics taught each inservice group, with the former presenting the mathematical ideas and the latter relating these ideas to pedagogy at the kindergarten and first grade levels. Separate inservice courses were scheduled for the teachers using the two different curricula (SRA and SMSG) so that applications of the mathematics background could be made directly to the curriculum being used by each teacher.

III. Description of Beginning and End-of-Year Tests

A. Individually Administered Tests

The initial test battery given in September of the kindergarten year, referred to as K01, was planned as an evaluation of readiness for learning mathematical concepts. K02, given in May, was planned to assess gain over the school year. Both K01 and K02 were individually administered inventories. The decision to develop and use individually administered tests had been made during the previous pilot testing period[1] after reviewing published group-administered tests of mathematics achievement available for kindergarten and grade one. The judgment was made that the group tests demand that the children give careful selective attention to a directed portion of a complex printed page (albeit pictorial representations rather than words); that they be able to follow somewhat difficult verbal directions directed to the entire group; and that they be able to make responses to these directions by manipulating a crayon or pencil in an appropriate manner. Since these skills tend to be less well developed in children from disadvantaged backgrounds, their performance on the test is likely to be adversely affected by the test format and situation, apart from substantive achievement.

K01 and K02 were developed to minimize possible differential between disadvantaged and more advantaged children in handling the test situation and materials. The tests were devised so that the children responded, in most tasks, to concrete materials. When printed drawings were employed as test materials, they were used as parallel forms to those tests utilizing concrete objects. Verbal directions given by the tester were brief, simple statements, and verbal responses were necessary in few of the test items. For those items requiring the children to make a verbal response, a single word or short phrase was sufficient.

Although each test took about forty minutes to administer, both the task and the materials varied frequently during this period of time. Thus, the requirement of a long attention span for good performance on K01 and K02 was considerably reduced.

All of the tasks included within the KO1 inventory were given to every child within the study sample. For KO2, however, certain tasks were given to all of the children, and each of the remaining tasks was given to one-fourth of the group. This procedure was necessary since the length of the test was approximately doubled because of extending certain tasks, developing parallel forms, and adding new tasks to the KO1 inventory.[2]

B. Cognitive Process Measures

Several tasks within the KO1 and KO2 inventories were used as indices of cognitive processes. These were Color - Matching, Naming, and Identifying; Classifying; Ordering; Geometric Shapes - Matching, Naming, and Identifying; Vocabulary; Visual Memory; and Conservation. The color inventory was included only in KO1 and Conservation included only in KO2. All of the others were given both at the beginning and end of the school year.

We assume that abstract concepts develop partly through awareness of certain regularities of events and, later, the categorization of these regularities. At the level of the five-year-old, such physical attributes of objects as size, shape, and color are used to systematize and categorize a wide range of perceptual experiences. The matching portions of the Color and Geometric Shapes' tasks were employed solely as perceptual tests to ascertain whether the children were able to match two cards embedded within two displayed sets of cards on the basis of shape or hue alone.

The Naming portions of these same tasks required the children to give names to specific colors and simple geometric shapes. Accurate performance on these items depends upon the children's experience in having had a particular label (e.g. red or circle) consistently attached to a particular hue or shape, and being able to say that word when the appropriate perceptual stimulus is presented. The Naming section was always given before the Identifying so that the child would have to provide the color and shape names.

The Identifying portions of the Color and Geometric Shapes' tasks required the children to identify and select a color or shape requested by the tester from a displayed set. This task demands, in addition to having the particular color or shape name attached to certain perceptual stimuli, that the child "keep in mind" the requested object while scanning the presented set to locate the appropriate object, whose only property differentiating it from the others is its color or shape, according to the specific task.

The Ordering and Classifying tasks required that the child rely on perceptual cues, and in addition, that he have certain concepts of shape and of size relationships. In KOl, the test materials for both Ordering and Classifying were geometric shapes of varying size and color. The difficulty of the Classifying items was varied by the number of attributes upon which classification was required.

Two kinds of mediating processes that appear necessary for symbol manipulation and that were measured as cognitive process variables were vocabulary and visual memory. When the child is able to manipulate words and visual images representing objects or experiences, rather than having to have the concrete object in his presence, then he is better able to use his experiences for more abstract symbolic thinking.

Although there are many facets of language learning relevant to cognitive development, the most relevent for the ELMA study is the vocabulary necessary for understanding mathematical concepts and relationships. Mathematics has a precise language. At this age level, however, perhaps more important than the precise language of mathematics, is some vocabulary which the children can use as labels for certain manipulations. In developing the concept of sets, for example, such expressions as "more than," "fewer than," and "as many as" are crucial. For the early pre-geometry ideas, such words as inside, outside, and on are critical. The ability to understand these words as shown by manipulating blocks appropriately was the means used to assess the vocabulary of the kindergarten mathematics program.

Our definition of visual imagery is the mental representation of objects and actions which stand for actual objects or events experienced by the child, and which can be manipulated in thought, as a step beyond the necessity of manipulation of the concrete, here-and-now events.

The usefulness of visual imagery in concept performance is a moot issue, but as Bruner[3] states, "The concentration upon surface properties of the environment and the conservation of these properties through imagery seem to constitute a stage of growth that bridges the gap between the rigid serial representation of earlier enactive representation and the language-saturated phase of later childhood...." (Ibid, p. 28).

The measurement of visual memory within the K01 and K02 batteries was through recall and recognition responses to a removed object which the child had been shown. To minimize the possibility of disadvantaged children not succeeding on this task because of a language handicap, simple familiar objects such as a toy car and dog were used in the form which will be referred to as Visual Memory-Objects. In the parallel form, denoted as Visual Memory-Pictures, drawings of familiar objects were used.

C. Mathematics Achievement Measures

The separation of those tests identified as "Cognitive Process Variables" from those included as "Mathematics Achievement Measures" was somewhat arbitrary; the two are clearly not disjoint sets. The major criterion for calling a specific task a measure of cognitive process was that, in addition to being a learned relationship or understanding, its presence indicates a certain level of cognitive development.

Those tasks here called Mathematics Achievement Measures included counting objects and members of a set, forming equivalent sets, numeral writing and identification, and ordinal number.

Cardinal counting was assessed in two different ways. In the first, the child was asked to count out a specified number of buttons from a larger set of buttons provided him. The other type of task

provided a set, in this instance, the pictures on a card, whose members he had to count.

Manipulation of set materials prior to operations on numbers is the approach used in the SMSG primary books. Among the activities included is that of set comparison which is employed to establish the concept of equivalence and to provide practice with both vocabulary and the idea of sets with more or fewer members. This activity, in turn, leads to work with numbers greater than, equal to, and less than other numbers. Some of the set comparison ideas were assessed in the Vocabulary test discussed previously.

The concept of equivalence was tested in both K01 and K02. In K01 it was tested by requesting the child to form a set equivalent to that represented by a group of pictured dots on a card. In K02 it was retested in this form. In addition, a parallel form was included in K02, with the given set consisting of concrete objects presented in the same patterns as the dots on the cards.

To compare sets and arrange them by the number of members within each set, it is useful, though not imperative, for the child to have some concept of ordinal number. The vocabulary of ordinality is part of the everyday language of the kindergarten teacher, e.g. taking turns, the first child in line, and references to the sequencing of activities during the school day. The meaning of "first," "fourth," etc., may be more explicitly taught through the ordering of sets by the number of members contained within each set or through establishing and naming positions of objects within a set. Ordinality was tested apart from cardinality by requesting the child to place marbles in specified (e.g. second) toy trucks which were lined up in front of him.

The ability to write and to identify numerals is a clear prerequisite for work in mathematics. A certain amount of eye-hand coordination is necessary for a five or six-year old to be able to form numerals. In order to identify them, he must have a number name associated with the written symbol. The explanation for the identification portion of this task was so phrased that the numeral which the child had to identify stood for the number of discs within a sealed envelope on the front of which the numeral was printed. On

the numeral writing portion, the child was asked to write the numeral which showed how many buttons were in a box.

IV. Results

The results will be presented by the grouping of tests specified in the test description, that is, cognitive process measures and mathematics achievement measures at the beginning and end of the school year.

As a general statement of findings, the children from the lower socio-economic groups performed less well on all but one of the tests at the beginning of the school year.[4] By the end-of-year testing, the means of both socio-economic groups on each of the tests were considerably higher.[5] The means of the lower socio-economic group continued to be lower than those of the higher group at the end of the year, but the lower group gained significantly more than did the middle group on several of the tests.[6]

A. Fall Testing

1. Cognitive Process Measures

The two measures obtained as indices of perceptual development were the matching scales of the Color and Geometric Shapes Inventories. Performance on both of these at the beginning of the school year was very good. On matching of geometric shapes, the circle and triangle were considerably easier for the children to match than were the square and the rectangle. The number of children out of the total 2022 tested who made an error on matching circles was 41 and on squares, the most difficult shape, 163 children made errors.

Matching of colors was an even simpler task than matching shapes for these beginning kindergarten children, with only 30 children making an error in matching yellow, and 85 of the 2022 making an error on green, the color with the highest frequency of error. Thus, most of the children in this group have the perceptual development necessary to discriminate colors and simple geometric shapes.

Naming and identifying colors are clearly more difficult than matching, with approximately one-third of the children unable to name "green" or "blue", the most difficult as judged by the number of errors made, while black, red, and orange were considerably better known and named by between 83 and 85 percent of the children. Identifying colors proved to be somewhat simpler than naming, probably because the children were able to recognize the color names when the tester provided them and could then hand the tester the appropriate card.

Few of the children knew names for the four two-dimensional geometric shapes tested. More of the children (882 of 2022) could correctly call a circular shape a "circle" and almost as many (842) could name a square shape. As with the color tasks, the children were better able to identify geometric shapes than to name them. About 75 percent of the children could correctly identify a circle, 60 percent could identify a square, and approximately 50 percent could identify a triangular shape. Less than 33 percent of the children were able to identify a rectangle.

Those tests identified as "Classifying" and "Ordering" required the children to select all of the circular shapes, for example, from a group of two-dimensional shapes including triangles, rectangles, and squares as well as the circular shapes. Additional kinds of tasks included were ordering, by size, a set of triangular shapes; handing the tester the smallest of a set of shapes; and deciding whether a presented set of shapes contained, for example, more circles or more blue rectangles. The rationale for such tasks is that children must use attributes of objects for generalizing similarities across many classes of objects and for discriminating differences among them. As stated earlier, size, shape, color, and combinations of these attributes are among those available to and manipulable by primary age children.

Approximately 32 percent of the children were able to order the shapes from smallest to largest. When asked to select all the circular shapes from among the other shapes, about 75 percent of the children were able to select appropriately. When asked to sort by <u>both</u> shape

and color (e.g. triangles and red), the task proved more difficult with 43 percent of the children able to do this correctly. The most difficult items of the Classifying and Ordering tests were those of the type requiring comparison of two subsets of a set, e.g. more circles or blue rectangles, within a larger set of shapes.

Performance on many of the words included within the Vocabulary test was excellent. More than 90 percent of the children were able to manipulate the blocks to show their understanding of such words as behind, tallest, inside, on, and top. The most difficult of the twenty words and phrases included were the expressions "as many as," with 48 percent of the children correct, and "fewer than," with approximately 30 percent correct. The fact that both of these terms are comparative expressions should make their greater difficulty easier to explain; however, 80 percent of the children correctly defined another comparative expression, namely, "more than."

As stated at the beginning of the results section, the lower socio-economic group performed less well than did the middle socio-economic group on almost all of the KOl tests. The one exception to this general statement was Visual Memory on which performance of the two groups was not significantly different. Either by recalling a removed object or by recognizing it when it was presented in the context of a new set of objects, between 78 and 96 percent of the children were able to name the removed object, depending upon the specific test item. Further analyses have shown the children's performance on Visual Memory to be unrelated to their achievement on any of the other tests. It is not possible to assess at this time whether visual memory, as measured, will predict performance on more abstract mathematical problems in future school years, but testing of this process will be repeated during second grade.

2. Mathematics Achievement Measures

Results on the two separate counting tasks were very similar. More than one-half of the children were readily able to count out 3, 4, or 5 buttons. The same statement may be made for counting 4 or 5

pictures although the counting of objects was somewhat simpler, in most instances, than counting drawings on a card as shown in the following table.

Table 1

Results for the Total Sample on Counting Objects and Pictured Sets, Fall Testing

	Percentage of Children able to Count Correctly	
Number Asked	Buttons	Pictures
3	84.3	---
4	64.8	71.5
5	61.5	58.7
6	52.7	43.1
7	44.9	47.4
8	44.2	38.4
9	37.0	30.5

On sets of four and seven, more of the children correctly counted the pictures than were able to count the same numbers of buttons. This is an exception to the previous statement that, in general, performance was better on counting buttons than on counting pictures. A possible explanation for this lies in the arrangement of pictures on the cards. For both the cards with four and with seven pictures, the arrangement of pictures was patterned rather than being randomly placed, which probably facilitated the counting task.

The results on counting just presented were for the entire sample of children being studied. When this sample is split into lower and middle socio-economic groups, differences in performance of the two population groups became quite apparent. The average (mean) number of buttons counted by children in the lower group was 5, and

the average for the middle group 8. On counting pictures, the mean for the lower group was almost 5 and for the middle group 7.

As was noted at the beginning of the results section, statistically significant differences were found between the two socio-economic groups on all of the tests given at the beginning of the school year, with the exception of Visual Memory. The largest differences, statistically, were found on the two counting tasks just discussed and on the Identification of Numerals' test.

In this latter test, Identification of Numerals, the children were shown a set of envelopes, each with a numeral printed on the front. Inside the envelope was the number of counting discs represented by the numeral, and the child was requested to hand the tester the envelope with 3, then consecutively, 1, 4, 5, 0, 8, 7, and 9 discs inside. The lower socio-economic group children, on the average, were able to correctly identify 3, 1, and 4. The middle group children were, on the average, able to do the above three plus 5 and 0.

The three mathematics achievement tests which were most difficult for the majority of entering kindergarten children, regardless of socio-economic level, were Writing Numerals, Equivalent Sets, and Ordinal Number, although on each test the middle socio-economic group performed better than did the lower group.

It was expected that few of the child would be able to form numerals at the beginning of the kindergarten year; hence, the children were asked if they would like to write down on a pad of paper the number of buttons they had put into the box. Implicit in the directions was the option to refuse, in which instance the tester accepted the refusal and wrote the numeral herself. On the first item of this test, 38.5 percent of the children did not wish to try. Of the 61.5 percent who attempted to form the numeral "3", the first item, less than one-third were able to do it correctly.

For the Equivalent Sets task, the children were requested to form a set of buttons equivalent to the set of dots on a series of cards. The first card had 5 large black dots drawn on it; the second had 4; the third 8; and the fourth of the six cards had 6 dots. The

mean number of the six items correctly performed by the lower socio-economic group was 2.4 and by the middle group 3.6. The largest percentage of correct responses, across the two population groups, was on the equivalent set card with four dots, the smallest number included within this particular test. This latter finding appears consistent with the results on the two counting tasks which suggested that the task becomes increasingly difficult for this age group as the children have to deal with numbers larger than five.

The results on the Ordinal Number test show that these children had little understanding of the concept of ordinality at the beginning of the kindergarten year. On the first item of this task, the children were asked to place a marble in the "first" truck of a series of five such toy trucks lined up. Seventy-five percent of the children placed the marble in the truck at either end of the line, either being correct since the child was allowed to establish which end of the line was "first". When asked on the third item, however, to place a marble in the "fifth" truck, only 12 percent were able to respond correctly.

3. Behavior Ratings

In addition to the test scores, ratings were made by the testers immediately after each test on two facets of the children's behavior observed during the testing period. These were Response to Verbal Directions and Attention to Task.

Most of the children were very attentive and task-oriented throughout the test, and no difference was found between the lower and middle groups on the Attention to Task ratings. On the Response to Verbal Directions rating, it is interesting to note that although most of the children tried to comply with directions, a significant difference was found between the lower and middle population groups, with the middle group rated higher on this behavior. This finding is consistent with reports of disadvantaged children[7] indicating their lack of experience with adults who rely on frequent and, often complex, verbal communication.

B. Changes from Fall to Spring Testing

The spring test findings will be presented as changes over the school year rather than in the form of a profile of the children's performance on each test as was done for the fall results. The results reported in this section are limited to those tests given at both the beginning and at the end of the kindergarten year.

1. Gains for the Total Sample over the School Year

Significant increases in mean test scores were found for the entire sample over the school year. For each of the cognitive measures as well as for the mathematics achievement measures, the mean scores were significantly higher at the end of the school year than at the beginning. If the improvement were due solely to the children's familiarity with the test, the pattern of statistically significant increases would probably not be as consistent. Thus, it appears that an important amount of learning has taken place over the course of the kindergarten year.

2. Socio-economic Group Differences

Although significant gains were made by the total population of children studied, the pattern of differences between socio-economic groups found at the beginning of the kindergarten year was repeated at the end of the year.[8] The middle group was still significantly higher on all test scores, except for Visual Memory, as they had been in the fall. What is crucial to point out, however, is the differential pattern of gain over the school year.

Table 2

Comparison of Gain Scores for the Two Socio-Economic Groups over the Kindergarten Year

Greater Gain * Shown by Lower Socio-economic Group	Greater Gain * Shown by Middle Socio-economic Group	No Difference between Gain Scores
Identification of Geometric Shapes	Ordering Geometric Shapes	Naming Geometric Shapes
Counting Buttons	Writing Numerals	Classifying
Counting Pictured Sets	Ordinal Number	Vocabulary
Identification of Numerals		Visual Memory-Objects
Equivalent Sets		Visual Memory-Pictures

* t is significant at the .05 level, two-sided test.

Table 2 shows the tests on which each socio-economic group made greater gains and those tests on which the difference between gains of the two groups from fall to spring was not statistically different. As was noted earlier, the lower socio-economic group performed less well than did the middle group on all of the tests at the beginning of the school year, but this lower group made significantly greater gains over the year on five of the tests, while the middle group made greater gains on three. In addition, the result showing no difference between the two groups' gain scores on five of the tests, (third column in table 2), provides further support to an interpretation that a structured mathematics program in kindergarten may narrow the differences in achievement of the lower and middle socio-economic groups.

The specific tests on which the lower group made greater gains appear to be those measuring skills and concepts of a rather basic nature. For example, the ability to count and to form equivalent sets may be prerequisite to progress in handling arithmetic operations. The significant gain on the two identification tests suggests an increased ability to associate verbal labels with shapes or numerals.

The fact that a significantly greater gain was made by the middle socio-economic group on ordering of geometric shapes and ordinal numbers when these children performed at a higher level on all of the tests at the beginning of the year suggests that they were able to move ahead more rapidly on ideas requiring relationships and comparison. Ordering by size requires that a child be able to understand a comparison among all of the members of a given set. Ordinal numbers, too, demands an understanding of the interrelatedness of the members of a specified set.

An interpretation for the greater gain made by the middle group on writing numerals may be the greater pre-school experiences with paper and pencils that these children have had, and therefore, greater readiness for writing symbols. It may also be that the numerals have more meaning and are more easily written because of this combination of the necessary motor coordination with the ability to identify the numerals.

For only one of the tests on which no difference between the two groups in gain scores was shown could the finding be attributed to the test itself. This is Naming - Geometric Shapes for which the mean of the middle group is sufficiently high that the test may have been too easy. This "low ceiling" for the test could make the middle and lower groups appear more similar than they would have been had there been a larger number of items and more difficult items. For the other tests, i.e. Classifying, Vocabulary, and the two Visual Memory forms, the lack of significant difference in gain scores suggests that the children in the two socio-economic groups are moving at about the same rate although from different base-lines.

On the behavior ratings made by the testers, the children looked very similar at the end of the year to the way they appeared to the testers early in the fall. The means were somewhat higher in the spring on both Response to Verbal Directions and Attention to Task. The pattern of difference found in the fall, with the two socio-economic groups being rated very similarly on Attention to Task and with the middle socio-economic group rated significantly higher than the lower group on Response to Verbal Directions, was maintained. Here, as with certain of the test findings discussed previously, although all of the children made gains in their handling of the test situation itself, the pattern of difference between the two socio-economic groups seen at the beginning of the school year on responding to verbal directions did not change.

V. Summary and Conclusions

This progress report has included a description of the Elementary Mathematics Study, its purpose, design, and kindergarten testing procedures. The results presented dealing with the first year of this four-year study were in the form of a profile of the children's performance on specific tests of cognitive development and of mathematics achievement. In addition, differences in performance between the lower and middle socio-economic groups on these tests were discussed.

Gains over the school year on both the cognitive and mathematics achievement tests were shown to be significant for the study population. The pattern of gains was, however, different for the two socio-economic groups. Although it is possible to describe the children's performance at both the beginning and end of the kindergarten year and to specify the differential pattern of gain for the two broad population groupings, it is not possible to predict how these children will perform by the end of third grade, or even by the end of first grade. It is hoped that by collecting data on this group of children over a four-year time span, along with some knowledge of the mathematics programs they are using and the training of their teachers, more effective programs for teaching primary mathematics can be developed.

Footnotes

1 Descriptions of the pilot studies can be found in Leiderman, Gloria F., Chinn, W. G., and Dunkley, M. E., SMSG Reports No. 2, The Special Curriculum Project: Pilot Program on Mathematics Learning of Culturally Disadvantaged Primary School Children. Stanford University, 1966 and Chinn, W. G. and Summerfield, Jeanette O., SMSG Reports No. 4, The Special Curriculum Project: 1965-1966. Stanford University, 1967.

2 This report discusses only those tests given at both the beginning and end of the kindergarten year. A technical report covering all of the testing done during both kindergarten and first grade will be prepared for publication in winter, 1968.

3 Bruner, J. S., Olver, Rose R., Greenfield, Patricia M., et al, Studies in Cognitive Growth, New York: John Wiley and Sons, Inc., 1966.

4 Table 1 of the Appendix gives the means, standard deviations, and t-test values for the two socio-economic groups on the KO1 test.

5 Table 2 of the Appendix gives the means, standard deviations, and t-test values for the two socio-economic groups on the KO2 test.

6 Table 3 of the Appendix gives the differences in means between KO1 and KO2 and the t-test values for the two socio-economic groups on these gain scores.

7 Hess, R. D., and Shipman, Virginia C., Early experience and the socialization of cognitive modes in children, Child Development, Vol. 36, No. 4, 1965, pp. 869-886.

8 See Table 2 of the Appendix for end-of-year (KO2) means by socio-economic group and Table 3 for gain scores over the year.

Appendix:

Tables of Test Results

Table 1

Mean Scores of KOl Scales (Fall Testing)

for

Low (L) and Middle (M) Socio-Economic Groups

		Group L (748 < N < 870)		Group M (659 < N < 693)		Group L - Group M	
Sub-test	No.of Items	Mean	Standard Deviation	Mean	Standard Deviation	Diff. Mean	t
Geom. Shape-Name	4	1.11	1.21	1.52	1.09	-.41	-6.63*
Geom. Shape-Ident.	4	1.98	1.32	2.62	1.22	-.64	-9.87*
Count Buttons	7	3.16	2.59	4.97	2.33	-1.82	-14.58*
Write Numerals	7	0.62	1.52	1.27	2.08	-0.66	-6.96*
Count Set-Picture Cards	8	2.94	2.81	4.84	2.77	1.90	-13.36*
Ident. Numerals	8	3.17	2.93	5.26	2.84	-2.09	-14.22*
Vis. Mem.-Objects	5	3.27	1.24	3.15	1.32	0.12	1.78
Vocabulary	15	8.76	2.79	10.40	2.51	-1.64	-12.20*
Equiv. Sets-Dots	6	2.37	2.16	3.63	2.02	-1.26	-11.87*
Ordinal Number	8	2.91	1.66	3.83	2.02	-0.92	-9.69*
Order-Geom. Shapes	2	0.54	0.75	0.97	0.89	-0.42	-9.98*
Classify	9	3.34	1.99	4.68	1.91	-1.34	-13.52*
Vis. Mem.-Pictures	4	0.98	1.03	1.21	1.05	-0.24	-4.40*
Resp. Verbal Directions	4	3.56	0.63	3.70	0.56	-0.14	-4.70*
Attn. to Tasks	4	1.69	0.93	1.73	0.99	-0.04	-0.82

* t is significant at the .05 level, two-sided test.

Table 2

Mean Scores of K02 Scales (Spring Testing)

for

Low (L) and Middle (M) Socio-Economic Groups

	Group L			Group M			Group L - Group M	
Sub-test	Mean	S.D.	N	Mean	S.D.	N	Diff. Mean	t
Geom. Shape-Name	2.83	1.15	208	3.39	.92	187	-.56	-5.38*
Geom. Shape-Ident.	3.19	1.09	887	3.54	.83	754	-.35	-7.42*
Count Buttons	5.33	2.28	227	6.70	.76	189	-1.37	-8.49*
Write Numerals	3.01	2.61	227	4.70	2.04	189	-1.68	-7.39*
Count Set-Picture Cards	5.02	2.35	887	6.14	2.12	754	-1.12	-9.52*
Ident. Numerals	6.18	2.48	226	7.59	1.15	189	-1.42	-7.66*
Vis. Mem.-Objects	3.47	1.15	230	3.54	1.09	197	-.07	-.68
Vocabulary	10.85	2.65	227	12.82	2.04	189	-1.97	-8.56*
Equiv. Sets-Dots	4.08	2.05	887	5.07	1.36	754	-.99	-11.67*
Ordinal Number	4.47	2.11	208	6.10	1.98	187	-1.63	-7.92*
Order-Geom. Shapes	.92	.93	887	1.64	.71	754	-.73	-17.98*
Classify	5.50	1.89	208	6.62	1.47	187	-1.12	-6.62*
Vis. Mem.-Pictures	1.36	1.07	222	1.55	.93	181	-.19	-1.92
Resp. Verbal Directions	3.75	.54	887	3.84	.40	754	-.09	-3.97*
Attn. to Tasks	1.38	.76	887	1.35	.75	754	.03	.75

* t is significant at .05 level, two-sided test.

Table 3

Kindergarten Year Mean Gain Scores

(K02 Scores minus K01 Scores)

for

Low (L) and Middle (M) Socio-Economic Groups

	Group L			Group M			Group L - Group M	
Sub-test	Diff. Mean	S.D.	t	Diff. Mean	S.D.	t	Diff. Mean	t
Geom. Shape-Name	1.84	1.50	16.05*	1.90	1.14	21.09*	-.06	-0.43
Geom. Shape-Ident.	1.25	1.51	23.86*	0.93	1.45	16.87*	.31	4.11*
Count Buttons	2.19	2.31	14.22*	1.57	2.07	10.00*	.62	2.83*
Write Numerals	2.35	2.50	14.07*	3.30	2.39	18.27*	-.95	-3.86*
Count Set-Picture Cards	2.11	3.10	20.00*	1.30	2.82	12.13*	.80	5.35*
Ident. Numerals	3.08	2.79	16.46*	2.19	2.54	11.39*	.89	3.31*
Vis. Mem.-Objects	0.30	1.57	2.90*	0.34	1.59	2.90*	-.04	-.23
Vis. Mem. Obj.	0.81	6.43	1.45	0.58	6.89	0.94	.23	.27
Vocabulary	2.30	2.60	13.28*	2.60	2.31	14.86*	-.30	-1.22
Equiv. Sets-Dots	1.73	2.27	22.46*	1.45	2.13	17.90*	.28	2.52*
Ordinal Number	1.54	2.00	11.02*	2.35	2.13	14.40*	-.81	-3.76*
Order-Geom. Shapes	0.38	1.03	10.79*	0.69	0.98	18.32*	-.31	-5.96*
Classify	2.15	1.97	15.55*	1.91	2.12	11.76*	.24	1.10
Vis. Mem.-Pictures	0.31	1.34	3.35*	0.32	1.37	2.96*	-.01	-.06

* t is significant at .05 level, two-sided test.